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EVALUATION OF AN AUTOMATIC MASHED
POTATO DISPENSER

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) A commercial mashed potato dispenser was examined and tested to determine its potential application to military serving line operations. The unit conformed to dimensions, power requirements, potato mix and water tank capacities, dispensing rates and range as advertized by the manufacturer. It was noted however that the machine did not have the capacity to dispense continuously more than 22 average size servings. Further, the quality of the		

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dispensed product, although considered acceptable, was not as good as that mixed by conventional means. With some improvements as discussed herein, the unit could be used in small serving lines where convenience is of utmost importance.

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EVALUATION OF AN AUTOMATIC MASHED POTATO DISPENSER

INTRODUCTION

An automatic mashed potato dispenser manufactured by Cornelius Co., of New Hope, Minnesota has been evaluated as part of a broader study of dispensing and serving equipment directed at automation of serving line operations. The purpose of this evaluation was to determine first, the capability of the dispenser to meet the manufacturer's advertised specifications, second, the equipment capacity and finally, the quality and acceptance of the dispensed product.

DESCRIPTION OF MASHED POTATO DISPENSER

The mashed potato dispenser evaluated, shown in Figure 1, is National Sanitation Foundation (NSF) and Underwriters' Laboratories (UL) approved. It is a thermostatically controlled countertop unit, compact, lightweight and equipped with a stainless steel inclosure. The unit was designed originally to operate with French's* granular dehydrated potatoes and incoming water pressure of 1.4×10^5 to 8.6×10^5 Pascals (20 to 125 psig) to dispense portion controlled servings of mashed potatoes by manually depressing the small or large button shown in Figure 1. Hot water and potatoes come in contact in the mixing chamber only when the small or large serving button is depressed thus eliminating crust and discoloration occurring in steam table held mashed potatoes. The water button, however dispenses water only while depressed and is used to flush the blending chamber with hot water for cleaning after each meal period. Both the small and the large portion sizes can be adjusted within the limits indicated under "Specifications" using adjustment screws located behind the lower front cover as shown in the illustration. Also shown is a water adjustment screw which can be used to change the texture of the dispensed product by increasing or decreasing the amount of water. Portion size adjustments are based on changes in filling time while water adjustments are based on flow control. Included with the dispenser are a short extension tube, a long extension tube and a forming cup as shown. The short tube may be used with large servings and the long with small servings to reduce splashing. The forming cup may be used as a scoop to collect and deposit mashed potatoes on the dish.

SPECIFICATIONS

1. Nameplate Data:

- a. Model No. 39-3065 - 000
- b. Serial No. 00162
- c. Voltage = 120, Hertz = 60, Amps = 13.6, Watts = 1580

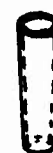
*Product of R. T. French Co., Rochester, NY



FORMING CUP



EXTENSION TUBE
SHORT



EXTENSION TUBE
LONG

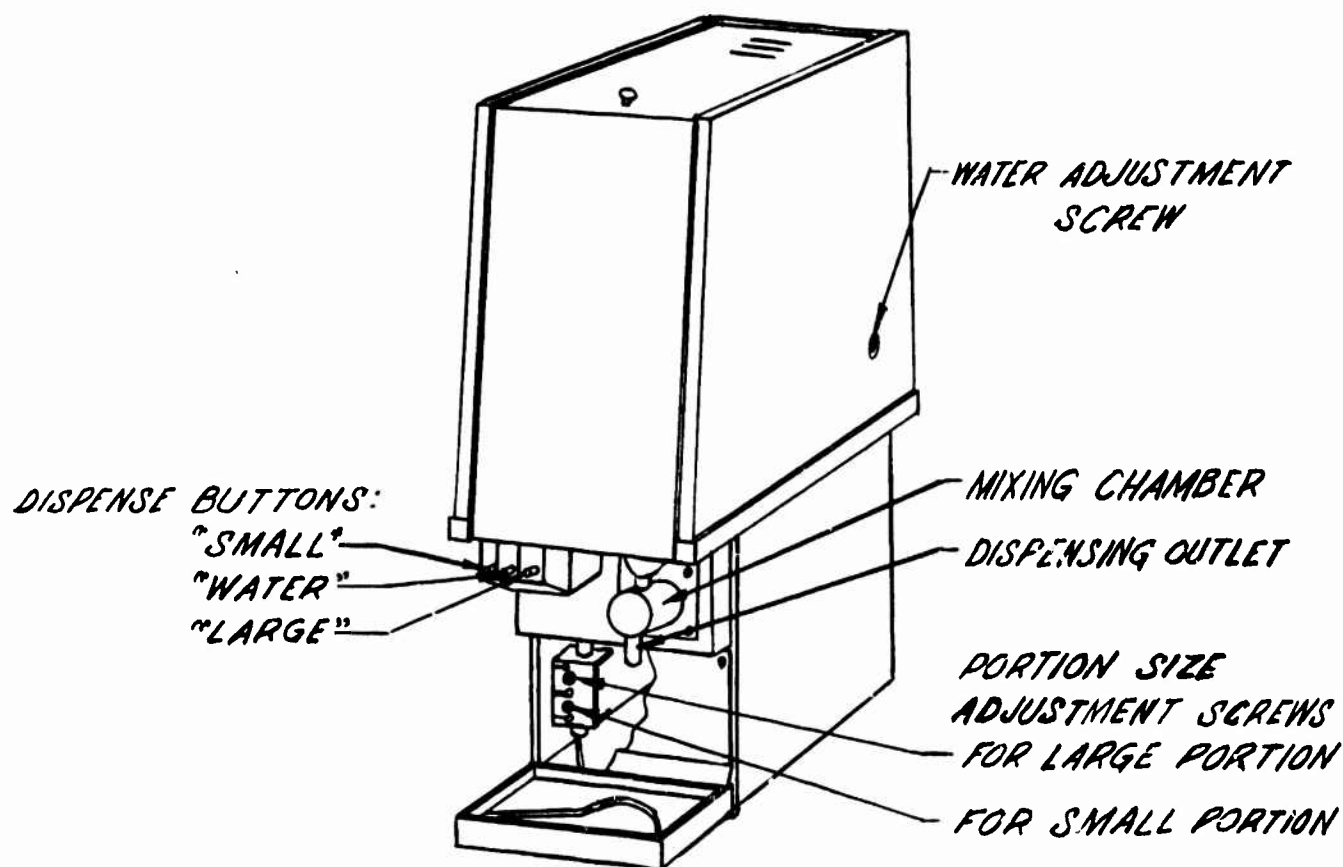


FIGURE 1. GENERAL VIEW OF
AUTOMATIC MASHED POTATO DISPENSER

2. Outside Dimensions:

- a. Height = 63.5 cm (25 in)
- b. Width = 23.5 cm (9-1/4 in)
- c. Depth = 60.96 cm (24 in)

3. Dry Weight:

- a. 19.96 Kg (44 lbs)

4. Machine Capacities:

- a. Product cannister = 4.99 Kg (11 lbs)
- b. Tank water capacity = 5.03 Kg (11.1 lbs)
5030 cm³ (170 fl. oz.)

5. Dispensing Range:

- a. Small serving size
70.88 gm to 113.4 gm (2.5 oz. to 4 oz.)
- b. Large serving size
170.1 gm to 453.6 gm (6 oz. to 16 oz.)

6. Normal Dispensing Rate:

- a. 3.8 servings/min of 99.2 gm/serv (3.5 oz./serv)
- b. 3 servings/4 min of 453.6 gm/serv (16 oz./serv)

7. Peak Dispensing Rate*:

- a. 35 servings/8 min of 99.2 gm/serv (3.5 oz./serv)
- b. 10 servings/12.5 min of 453.6 gm/serv (16 oz./serv)

*Based on 21.1°C (70°F) incoming water at a dispensing temperature of 73.9°C (165°F).

8. Tank Water Temperature Range:

- a. 82.2°C to 90.6°C (180°F to 195°F)

9. Tank Water Heating Element:

- a. 1500 watts

NOTE: Unless otherwise specified ounce (oz.) weights are in avoirdupois units.

INSPECTION

1. Examination. The unit was visually and manually examined for proper labeling, ease of operation, maintenance including cleaning, loading and general accessibility.

2. Tests. The unit was connected to water and power sources, and the cannister was filled with approximately 5 Kg (11 pounds) of Government issue potato mix conforming to JJJ-P-630B, type II, Style A and properly seasoned. Thermocouples and a readout meter were used to record inlet water, tank water and mashed potato dispensing temperature at the outlet. Tests were initiated upon reaching a tank temperature of 85°C (185°F) and a proper water to potato mix ratio hereinafter referred to as the regular setting of the water adjustment screw.

a. Dispensing range. Small and large servings were dispensed and weighed. Minimum and maximum serving weight limits were then established for both small and large serving size buttons by turning the portion size adjustment screw clockwise for more and counterclockwise for less. An attempt to dispense servings smaller than 70.9 gm (2.5 oz.) or larger than 453.6 gm (16 oz.) was not made since these extremes were not considered practical.

b. Normal and peak dispensing rates. The unit was adjusted to dispense 99.2 gm (3.5 oz.) per small serving and 453.6 gm (16 oz.) per large serving. With incoming water at approximately 26.9°C (80°F), small and subsequently large servings were dispensed by pressing and releasing the selected button during the time period specified to determine normal rates. Intervals between button actuations were intended to be indicative of normal serving line operations. An identical test was conducted to determine peak rates except that the button was continuously depressed.

c. Power consumption. Machine amperage was measured at the supply voltage using a digital amprobe. First, the current drawn by the heating element was measured during warm-up and second, the total current drawn by the machine while heating and dispensing was measured. These currents were used to compute heating element as well as power consumption ratings and compare with specified values.

d. Water output and adjustment. This test was to establish the water output per serving and the extent to which this output could be adjusted to change the texture of the product. With the machine adjusted to dispense small and large servings as stated under "Normal and peak dispensing rates" and product cannister removed, the volume of water dispensed for each of the two serving sizes was measured. In addition to determining the water output at these small and large portion settings, the effect of turning the water adjustment screw was also checked. This was accomplished by measuring the output in 1/8 turn increments in a clockwise and counterclockwise direction.

e. Capacity test. The purpose of this test was to determine the maximum number of servings that could be continuously dispensed and the elapsed time before the water temperature drops to a level inadequate for proper reconstitution. The unit was adjusted to dispense 283.5 gm per serving (10 oz. per serving), considered a typical military portion, and otherwise prepared and instrumented as explained under "Tests". The time required for the tank temperature to reach the operational point of 82.2°C (180°F) was also recorded.

f. Quality and acceptance tests. These were intended to compare such factors as appearance, odor, flavor, texture and overall quality of the dispensed product with a product mixed by conventional means. A number of individuals were asked to evaluate both products prepared from AFRS Recipe Q-57 containing 6 lbs 2 oz. of Government mix, 12 oz. of non-fat dry milk, 2 oz. of salt and 2 teaspoonsful of pepper.

FINDINGS

1. Examination:

a. Daily and weekly maintenance instruction label, although determined to be useful and complete, is located on the front side of the cannister behind the removable front panel of the machine and as such is not readily visible to kitchen personnel. In addition, the machine itself is not properly labeled or identified as a mashed potato dispenser for serving line customers.

b. Removal of cannister for internal cleaning is difficult, even with top door open and front panel removed, due primarily to the proximity of the side panels. Loading, however, can be easily accomplished without removing the cannister.

c. The machine does not have a light or similar device which would indicate that the tank temperature has reached 82.2°C (180°F) to 90.6°C (195°F) and the unit is ready for operation. Also lacking is an on-off switch to shut the machine down and conserve power when not in use.

d. In addition to calling for water when the level drops below a designated point, the float switch should also shut down the machine when incoming water is interrupted and level drops below the dispensing point. This would preclude improperly formed servings and eventual clog-up due to this condition.

2. Test Results:

a. Dispensing range. Portion size adjustment screws can be adjusted to minimum and maximum limits to provide the range specified. A number of servings may have to be dispensed and adjustments made before the exact portion size can be obtained since screws are not calibrated.

b. Normal and peak dispensing rates. Small servings were dispensed at a normal rate of 3.8 per minute and a peak rate of 4.8 per 8 minutes (per minute). Large servings were dispensed at a normal rate of 6 per 12 minutes and a peak rate of 25 per 12-1/2 minutes (2 per minute). Peak rates were based solely on machine cycle times. The cycle time for 99.2 gm (3.5 oz.) serving is 5 seconds "ON" and 4-1/2 seconds "OFF", for 283.5 gm (10 oz.) serving is 16 seconds "ON" and 14 seconds "OFF" and for 453.6 gm (1 lb.) serving is 25 seconds "ON" and 10 seconds "OFF". The delay in start-up after pressing the button is 1-1/2 seconds for the 99.2 gm (3.5 oz.) serving and 3 seconds for the other two. Rates were determined without regard to dispensing temperatures. These temperatures however were recorded in the capacity test. The normal rate for small servings is as specified, the rest however are evidently greater disregarding temperatures.

c. Power consumption. With a supply voltage of 115V, the current consumed by the heating element was approximately 12 amps and that consumed by the machine approximately 13 amps. Based on these figures, the heating element power consumption was 1380 watts and the apparent machine power consumption (heating and dispensing) which is always greater than the actual was 1495 watts.

d. Water output and adjustment. The amounts of water dispensed with small and large servings at the regular water adjustment setting and in 1/8 turn increments of the water adjustment screw are as follows:

<u>SERVING SIZE</u> <u>BUTTON PRESSED</u>	<u>WATER ADJUSTMENT</u> <u>SCREW SETTING</u>	<u>VOLUME OF WATER</u> <u>DISP. ML. (FL.OZ.)</u>	<u>WEIGHT OF WATER</u> <u>DISP. GM (OZ.)</u>
Small, 99.2 gm (3.5 oz. of mashed potato)	1/4 turn cw	51 (1.73)	51 (1.80)
	1/8 turn cw	64 (2.16)	64 (2.26)
	Regular	76 (2.57)	76 (2.68)
	1/8 turn ccw	88 (2.97)	88 (3.11)
	1/4 turn ccw	100.5 (3.40)	100.5 (3.55)
Large, 453.6 gm (16 oz. of mashed potato)	1/4 turn cw	240 (8.11)	240 (8.47)
	1/8 turn cw	310 (10.48)	310 (10.94)
	Regular	380 (12.85)	380 (13.41)
	1/8 turn ccw	450 (15.21)	450 (15.89)
	1/4 turn ccw	520 (17.58)	520 (18.36)

The rate of dispensing water at the regular water adjustment screw setting is 906.5 ml per minute (32 oz. per minute) regardless of serving size button pressed. Serving size button only affects filling time.

e. Capacity test. Results of the capacity test are as follows:

<u>SERVING</u> <u>NO.</u>	<u>TIME</u> <u>(MIN)</u>	<u>TANK TEMP</u> <u>°C (°F)</u>	<u>DISPENSING TEMP</u> <u>°C (°F)</u>	<u>REMARKS</u>
1	1/2	85 (185)	80.6 (177)	
2	1	87.8 (190)	81.1 (178)	
3		88.9 (192)	81.1 (178)	

<u>SERVING NO.</u>	<u>TIME (MIN)</u>	<u>TANK TEMP °C (°F)</u>	<u>DISPENSING TEMP °C (°F)</u>	<u>REMARKS</u>
4	2	88.9 (192)	83.3 (182)	
5		89.4 (193)	83.9 (183)	
6	3	89.4 (193)	84.4 (184)	
7		90 (194)	85 (185)	
8	4	89.4 (193)	85 (185)	
9		90 (194)	84.4 (184)	
10	5	89.4 (193)	85 (185)	
11		88.9 (192)	85.6 (186)	
12	6	88.9 (192)	84.4 (184)	
13		88.9 (192)	83.3 (182)	
14	7	88.9 (192)	83.3 (182)	
15		88.3 (191)	83.3 (182)	
16	8	88.3 (191)	82.8 (181)	
17		87.8 (190)	82.2 (180)	
18	9	87.2 (189)	81.1 (178)	
19		86.7 (188)	80 (176)	
20	10	84.4 (184)	78.3 (173)	
21		81.1 (178)	76.1 (169)	
22	11	78.3 (173)	73.9 (165)	----- Mashed Potatoes are Soupy - Unacceptable
23		76.7 (170)	72.2 (162)	
24	12	75 (167)	71.7 (161)	
25		73.3 (164)	70 (158)	
26	13	72.2 (162)	69.4 (157)	
27		72.2 (162)	69.1 (157)	
28	14	72.2 (162)	68.3 (155)	
29		71.7 (161)	67.8 (154)	
30	15	71.7 (161)	67.8 (154)	

The tank requires approximately 13 minutes to heat inlet water from 31°C (87.8°F) to 82.2°C (180°F). At the conclusion of the test inlet water temperature dropped to 28°C (82.4°F). As evidenced above, the 22nd serving dispensed 11 minutes after starting the test was too soupy and considered unsatisfactory, indicating that 73.9°C (165°F) is apparently the minimum mixing temperature.

f. Quality and acceptance tests. Both the dispensed and the mechanically whipped potatoes were rated on a nine point hedonic scale whereby each individual rated the sample from 1 (dislike extremely) to 9 (like extremely). The following are average ratings for 12 individuals participating in the quality test and 48 individuals participating in the acceptance test (22 testing mechanically whipped potatoes and 26 testing dispensed potatoes):

(1) <u>Quality Test</u>	<u>Mechanically Whipped Potatoes</u>	<u>Dispensed Potatoes</u>
Appearance	6.8	6.1
Odor	6.8	6.2
Flavor	7.0	6.1
Texture	6.9	6.2
Overall quality	6.9	6.2

(2) Acceptance Test

Mechanically
Whipped Potatoes

Dispensed Potatoes

7.0

6.5

In both tests mechanically whipped potatoes rated higher than dispensed potatoes.

CONCLUSIONS

The mashed potato dispenser evaluated meets all of the manufacturer's requirements as specified. The unit however has some drawbacks. First, the product dispensed by the machine using the Government mix does not have the quality and acceptance of the same product mixed by conventional means. This may be due to the unit mixing at a faster rate and incorporating less air than conventional mixing. Second, the capacity of the machine is not great enough for large serving line operations unless it is directly connected to potable hot water. If the quality of the dispensed product prepared from the Government mix were better, the unit as is could be used satisfactorily in small serving lines. Perhaps a better product can be obtained using the commercial mix specifically formulated for the dispenser, but it would not be taking advantage of a standard item already in the supply system. Moreover, certain improvements to correct deficiencies outlined under "Examination" and specifically incorporation of a low water level control should be made to improve further the utility of the unit.